ANTI-BACTERIAL MEDICAL WATERPROOF MATERIAL AND SHEET MADE OF THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention:

[0001] The present invention relates to an anti-bacterial waterproof material made of a circular knitted fabric woven with a nylon yarn containing an ultra-micro powder of silver effective in controlling the growth of various bacteria from the moisture associated with patient use, and more particularly, to a medical sheet made of the material of the present invention.

2. Description of the Related Art:

[0002] As our society ages, the number of the bedridden elderly is increasing annually. Many of these patients require an additional medical waterproof sheet placed beneath their lower back on a bed or other support surface.

[0003] Typical waterproof sheets used in medical facilities, such as nursing homes and hospitals are placed in the center of a mattress of a bedridden patient to prevent sweat, bodily fluid and/or waste of the patient from penetrating the mattress or support.

[0004] At the core of these conventional waterproof sheets is a polyurethane film to which a fabric is attached. This polyurethane film blocks the moisture of the patient's fluids from penetrating into the mattress or support.

[0005] However, these conventional waterproof sheets do not eliminate odor, are not anti-bacterial and are not designed to control the growth of bacteria such as MRSA, staphylococcus aureus, pneumobacillus and E.coli bacteria. See Japanese Unexamined Patent Application 7-39564.

[0006] Thus, there is a need for a medical anti-bacterial waterproof material that can be used as a sheet or other item which can control bacterial growth and/or eliminate odor.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is to provide a waterproof material that can be made into a sheet or other product for medical use to eliminate odor and bacterial growth.

[0008] Another object of the present invention is to produce a low cost, easily assembled waterproof sheet of a circular knitted fabric woven with a nylon yarn containing an ultra-micro

powder of silver ions to control bacterial growth and eliminate odor.

[0009] In accomplishing these and other objects of the present invention there is provided a waterproof material comprising a knitted fabric woven from a first yarn and a second yarn, the first yarn being a nylon filament containing ultra-micro silver ions and the second yarn being a polyester yarn. The fabric is made of approximately 20 to 40% of the first yarn and 60-80% of the second yarn.

[0010] In accomplishing these and other objects of the present invention there is provided an antibacterial waterproof sheet having a multilayer construction for controlling bacterial growth, eliminating odor and resisting wear, comprising a polyurethane film having an upper and lower side forming an innermost layer. A layer of polyurethane adhesive is disposed on each upper and lower side of the film. A layer of knitted material is disposed on each layer of adhesive forming opposed outer layers of the sheet. The knitted material is woven from a first yarn and a second yarn. The first yarn is a polyester yarn and the second yarn is a nylon filament containing ultra-micro silver ions.

[0011] These and other objects, features, aspects, and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiment relative to the accompanied drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Fig. 1 illustrates a length of nylon yarn containing the ultra-micro powder of silver ions used in the material of the present invention.

[0013] Fig. 2 is a perspective view of the fabric of the present invention.

[0014] Fig. 3 is a perspective view of an anti-bacterial waterproof sheet made of the fabric and according to the present invention.

[0015] Fig. 4 is a cross-section of the sheet of Fig. 3 taken along line I-I.

[0016] Fig. 5 is a perspective view of a mattress with the anti-bacterial waterproof sheet of the present invention placed thereon.

[0017] Fig. 6 is a perspective view of a pillow with the anti-bacterial waterproof sheet of the present invention placed thereon.

[0018] Fig. 7 is a perspective view of a bed with the anti-bacterial waterproof sheet of the present invention placed thereon.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0019] Referring to Figs. 1-3, the waterproof antibacterial material of the present invention is made of a circular knitted fabric 14 having a gauge of 28-32 weaves of fiber, one measurement of fiber equals one weave, 1 gauge of fiber. The fabric is circular knitted to increase softness, elasticity and flexibility.

[0020] The knitted fabric is woven, approximately 20% to 40%, with a first nylon yarn 10 having a length of 70D/24F to 140D/48F. Nylon yarn is desirable because of its hydrophilic properties, improving fluid absorption. Moreover, higher price and health concerns are limited by maximizing the content of the fabric to 20-40% nylon yarn. Use of a nylon yarn in excess of 40% can irritate or damage sensitive skin.

[0021] The yarn 10 is shown in Fig. 1 and is a filament containing ions of ultra-micro silver powder 12. The silver powder ions 12 are preferably 1 micron or smaller in size. Fabric 12 is comprised approximately 60-80% of a second 100% polyester yarn having a length of 70D/24F to 140D/48F for example, 450 meters with a quantity of 0.05 grams or 1 denier. This yarn material facilitates the generation of the silver ions from the ultra-micro silver powder 12. It should be appreciated that other yarns having the appropriate gauge and properties can be used.

[0022] As shown in Figs. 3 and 4, an antibacterial waterproof sheet 20 can be made using the material of the present invention. Referring to Fig. 4, the fabric 20 is applied to a polyurethane film 18 with a compatible polyurethane adhesive 16. Film 18 has a preferable thickness of 0.5 to 0.15 mm. The adhesive 16 is applied to the fabric which is then heated and pressed onto film 18.

[0023] The sheet is formed in a continuous motion, for example, by use of a pressure roller and pressure belt. Pressure within the range of 2.5 to 3.0 kg/m^2, a heating temperature range of 75 to 85°C, and a speed of 0.9 to 1.0m/min can be used to form the sheet.

[0024] A layer of fabric 20 is disposed on each side of film 18. Due to the multilayer construction, both sides of sheet 20 can be used for convenience, economy and practicality.

[0025] Accordingly, the waterproof sheet of the present invention has a multi-layer construction and enhanced resistance to bacterial growth, odor and wear from repeated washing and drying. In use, the sheet will prevent the moisture of sweat, bodily fluids or waste from infiltrating the mattress, futon or other support upon which it is placed.

[0026] The properties of the medical waterproof sheet of the present invention has been determined as follows:

Water resistance: 1500 mm or more (JISL 1092)

Water vapor permeability: 1,000 g/m^2/24 hrs or more (JISL 1099)

Full thickness: 0.5 to 0.75 mm (dial gauge)

Full weight: 200 to 330 g/m^2 (10cm x 10 cm conversion)

Cleaning: sample sheet withstood 100 washings with water (no dry cleaning)

[0027] Figs 5-7 illustrate working examples of the antibacterial medical waterproof sheet according to the present invention. As shown in Figs. 5 and 7, sheet 20 is placed at the center of a mattress 30, with both ends tucked thereunder. Fig. 7 illustrates the sheet of the present invention on mattress 30 of bed 36. Fig. 6 illustrates the sheet of the present invention as used on a pillow 32.

[0028] It should be appreciated that the waterproof sheet 20 of the present invention is not limited to medical applications, be can also be used in other environments and applications. Moreover, a pillow or mattress can be cover on its entire surface with the fabric of the present invention. Other contemplated uses and/or applications for the fabric and sheet of the present invention can include a cover for a stretcher, a pillowcase or protective cover for a carpet/rug to protect the same from moisture and stain.

[0029] The fabric and sheet of the present invention is especially effective in controlling the growth of various bacteria, including MRSA, staphylococcus aureus, pneumobacillus and E.coli bacteria. It also prevents odors associated with bacterial growth. Various anti-bacterial tests were conducted.

Table 1

[Test Item]

Anti bacterial test

[Bacteria]

MRSA Methicillin resistant Staphylococcus aureus IID 1677

[Test Method]

Standardized test method

[Test Results]

Planted bacteria count [A]	2.4×10^4	Log A 4.4
Bacteria count on untreated fabric [B]	1.3×10^7	Log B 7.1

(Untreated fabric: Standard cotton fabric)

Log B – Log A = 2.7 >1.5 … Test was effective.

Active bactericidal level = Log A – Log C

Active bacteriostatic level = Log B – Log C

Sample	Bacteria count Log C	Active bactericidal level	Active bacteriostatic level
With silver yarn	1.3	3.1	5.8

Table 2

[Test Item]

Anti bacterial test

[Bacteria]

Staphylococcus aureus ATCC 6538P

[Test Method]

JIS L1902 quantitative test (standardized test method)

[Test Results]

Planted bacteria count [A]	2.3×10^4	Log A 4.4
Bacteria count on untreated fabric [B]	1.3×10^7	Log B 7.1

(Untreated fabric: Standard cotton fabric)

Log B – Log A = 2.7 >1.5 … Test was effective.

Active bactericidal level = Log A – Log C

Active bacteriostatic level = Log B – Log C

Sample	Bacteria count Log C	Active bactericidal level	Active bacteriostatic level
Polyester 100%	5.5	-1.1	1.6
Polyester 100% (with silver)	1.3	3.1	5.8

Table 3

[Test Item]

Anti bacterial test

[Bacteria]

Klebsiella pneumoniae ATCC 4352

[Test Method]

Standardized test method

[Test Results]

Planted bacteria count [A]	1.9×10^4	Log A 4.3
Bacteria count on untreated fabric [B]	2.9×10^7	Log B 7.5

(Untreated fabric: Standard cotton fabric)

Log B – Log A = 3.2 >1.5 ... Test was effective.

Active bactericidal level = Log A – Log C

Active bacteriostatic level = Log B – Log C

Sample	Bacteria count Log C	Active bactericidal level	Active bacteriostatic level
With silver yarn	1.3	3.0	6.2

Table 4

[Test Item]

Anti bacterial test

[Bacteria]

Escherichia coli NBRC 3301

[Test Method]

Standardized test method

[Test Results]

Planted bacteria count [A]	2.1×10^4	Log A 4.3
Bacteria count on untreated fabric [B]	3.1×10^7	Log B 7.5

(Untreated fabric: Standard cotton fabric)

Log B – Log A = 3.2 >1.5 ... Test was effective.

Active bactericidal level = Log A – Log C

Active bacteriostatic level = Log B – Log C

Sample	Bacteria count Log C	Active bactericidal level	Active bacteriostatic level
With silver yarn	1.3	3.0	6.2

1	[A] Bacteria count on untreated sample immediately after planting (Log A)					
	[B] Bacteria count on untreated sample after 18 hour incubation (Log B)					
	[C] Bacteria count on treated sample after 18 hour incubation (Log C)					
2		MRSA	Staphylococcus aureus	Klebsiella pneumoniae	Escherichia coli	Pseudomonas aeruginosa
	Active bacteriostatic level Log B – Log C	5.8	5.8	6.2	6.2	1.9
	Effectiveness in controlling bacterial growth (compared to untreated fabric)	1/630,000	1/630,000	1/1,600,000	1/1,600,000	1/80
	Criteria for evaluating bacteria growth/odor control: (Log for staphylococcus aureus must be 2.2 or higher; generally 1/160 or less)					
3		MRSA	Staphylococcus aureus	Klebsiella pneumoniae	Escherichia coli	Pseudomonas aeruginosa
	Active bactericidal level Log A – Log C	3.1	3.1	3.0	3.0	-0.9
	Effectiveness in bactericidal activity (compared to initial bacteria count)	1/1,260	1/1,260	1/1,000	1/1,000	8 times

	Criteria for evaluating sterilization: Active bactericidal level must be: Log C < Log A C 0 (bacteria count must be less than initial count)			
4	The SEK (Japan Textile Evaluation Technical Council) mark specifies the following. [Bacteria to be Tested] include:			
	Bacteria to be tested for bacteria growth/odor control	Antibacterial/anti odor treatment	Bacterial growth control treatment	
			General application	Specific application (medical)
	Staphylococcus IID 1677 (MRSA)	---	---	☐
	Staphylococcus aureus ATCC 6538P (*)	☐	☐	☐
	Klebsiella pneumoniae ATCC 4352 (*)	---	☐	☐
	Escherichia coli IFO 3301 (*)	---	☐	☐
	Pseudomonas aeruginosa IFO 3080 (*)	---	☐	☐
	Note: ☐: Required; ☐: Optional; ---: Not applicable			

[0030] Although the present invention has been described in relation to particular embodiments thereof, many other variations and modifications and other uses will become apparent to those skilled in the art. It is preferred therefore, that the present invention be limited not by the specific disclosure herein, but only by the appended claims.